Research White Paper
SmartyAnts Reading World

Meeting the Needs of Students with Reading Disorders

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Introduction

Reading disorders are the most common cause of underachievement and academic failure in the United States. Although literacy is certainly not the only factor influencing how we live our lives, it is unquestionably a strong form of currency in our society, affording economic and social access, in addition to personal satisfaction. According to the National Assessment of Educational Progress (NAEP), which is the largest continuing assessment of American student achievement, 66 percent of all fourth and eighth graders scored below the proficient range in reading (U.S. Department of Education, 2011). The National Institute of Child Health and Human Development (NICHD) sees the intractable problem of illiteracy reaching beyond education, into the realm of public health:

> *The educational and public health consequences of this level of reading failure are dire. Of the 10 to 15 percent of children who will eventually drop out of school, over 75 percent will report difficulties learning to read. Likewise, only two percent of students receiving special or compensatory education for difficulties learning to read will complete a four-year college program. Surveys of adolescents and young adults with criminal records indicate that at least half have reading difficulties. Approximately half of the children and adolescents with a history of substance abuse have reading problems (Hearing on measuring success: Using assessments and accountability, 2001).*

Illiteracy paints with a broad stroke, affecting the emotional, cognitive, and economic well-being of those who struggle to read, as well as the health of society as a whole. The predictable and robust acquisition of spoken language that occurs spontaneously and innately in children (Hauser, Chomsky, & Fitch, 2002) stands in stark contrast to the varying levels of competence that children exhibit in reading. Given the short evolutionary history of written language—only about 5,000 years compared to oral language's 2.5 million-year history—the brain has not had the time or need to develop specialized circuitry for reading (Shaywitz, 2003). Consequently, there is no natural course of literacy development common to all children. Instead, reading acquisition and development spans a broad continuum that must be acknowledged and respected if all children are to find success. SmartyAnts was developed with great consideration to those children who struggle when learning to read.

Reading Disorders

In general, most struggling readers fall into two broad groups (Torgesen, 2004). The first group includes children who, despite adequate oral language development, have an underlying deficit in phonological processing. They are, by

nature, less sensitive to the sounds of language and have difficulty understanding the alphabetic principle—that symbols in print can represent those sounds. Consequently, remembering letter-sound associations, mapping sounds to symbols to read words, and creating mental representations of words for automatic and fluent reading is a tremendous challenge for these children. This cluster of symptoms that is sometimes referred to as dyslexia affects between 5-17% of the United States population, depending on the threshold used to define the impairment (Shaywitz, 2003), and results in slow and inaccurate reading, poor spelling, difficulty with written expression and, consequently, challenges in all academic endeavors. Current research has provided clear evidence that dyslexia is not due to a lack of intelligence or desire to learn, but rather to differences in brain organization and function. It occurs in people of all backgrounds and intellectual levels, often runs in families, and exists on a continuum from mild to severe (Dehaene, 2009).

Children in the second group display weaknesses in both oral language development and the phonological skills necessary for skilled reading. These may be English language learners, children with developmental delays in language, or economically and educationally disadvantaged children with fewer opportunities for rich language development. Because environmental conditions that affect oral language development also impact the growth of phonemic awareness, print awareness, and letter knowledge (McArdle & Chhabra, 2004), these children are doubly affected when it comes to learning to read.

The Development of SmartyAnts

SmartyAnts targets the needs of all struggling readers. Its research-based curriculum and pedagogy were created under the advisement of a core team of educators from Stanford University and the University of California, Berkeley:

- Dr. P. David Pearson, world-renowned reading researcher, professor, and dean emeritus of the University of California, Berkeley, Graduate School of Education.

- Dr. Robert Calfee, distinguished professor emeritus of the Stanford University School of Education, and dean emeritus of the University of California, Riverside, Graduate School of Education.

- Dr. Mia Callahan, graduate of Stanford University and the University of California, Berkeley, and seasoned reading teacher of 30+ years.

SmartyAnts is based on the findings of landmark intervention studies (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Torgesen et al., 1999; Vellutino, Scanlon, & Jaccard, 2003; Vellutino et al., 1996), and the most influential national research studies of the past 50 years (Adams, 1990; Anderson, Hiebert, Scott, & Wilkinson, 1985; Bond & Dykstra, 1967; Chall, 1967; National Reading Panel, 2000; Snow, Burns, & Griffin, 1998). Whether used as a preventive measure for at-risk children before reading failure occurs, or as an intervention for children who have fallen behind their peers in reading development, SmartyAnts offers struggling readers a successful path to literacy and all its attendant rewards.

Lessons Learned from Research:

7 Critical Components of Effective Reading Instruction for Children with Reading Disorders

1. **Instruction must be responsive to the individual needs of the child.** Children with reading disorders have varying learning profiles and needs (Allington & Baker, 2007; Snow et al., 1998). SmartyAnts targets instruction to maximize efforts in the areas of greatest need. It provides an initial assessment of each child's skill level in the Assessment Pool, placing him or her at the appropriate level to begin the program.

Assessment is ongoing as the child moves throughout all activities in the program—providing more practice, instruction, and guidance when needed, yet allowing the child to move quickly through concepts and skills that are easily mastered. Stanislaus Dehaene, one of the world's most active researchers on the cognitive neuroscience of language, suggests that computer programs are an ideal platform for differentiated instruction because they are able to generate thousands of training situations that can adapt to each child, adding that "the most impressive programs automatically detect the child's level and propose problems adapted to their abilities" (2009, p. 259). SmartyAnts does just that. All activities, no matter which area of the SmartyAnts World a child chooses to play in, are within what Russian psychologist Lev Vygotsky termed the "zone of proximal development," where new concepts are challenging enough to engage and stretch the child, yet scaffolded appropriately to maintain success and motivation.

2. **Instruction must be explicit.** While there is broad consensus among educators and reading researchers that explicit instruction is useful for all children (Adams, 1990; Chall, 1967; National Reading Panel, 2000; Snow et al., 1998), direct and explicit teaching is essential for children with reading difficulties (Foorman et al., 1998; Juel & Minden-Cupp, 2000; Shaywitz, 2003). We cannot assume that these children will acquire knowledge and skills on their own as they tend not to discover connections about print unless it is explicitly taught. The SmartyAnts program uses a personal "coach" who stays with the child throughout all activities in the SmartyAnts World, explicitly delivering instruction in an engaging, encouraging, and nonthreatening manner. The coach carefully explains every concept and strategy, each one building upon the next, as many times as needed for successful progress through the 11 reading levels. He guides the student through

more than 200 teaching and interactive videos that teach phonemic elements in words, letter names, letter sounds, strategies to decode and build new words, rhyming word families, spelling conventions, prefixes and suffixes, sight words, and automatic word recognition. After each lesson, the child has abundant opportunities to practice the skill in 10 interactive learning modules throughout the SmartyAnts World. Progress is carefully monitored during each session, with more explicit scaffolding provided for those who need it and less for those who are moving more quickly on a particular skill.

In addition to directly teaching skills at the word level, SmartyAnts provides explicit instruction in vocabulary development, text structure, and comprehension through authentic reading experiences of decodable texts and language-rich stories from Candlewick Press that are read aloud to them in the Story Quiz Show. The story reader models fluent reading, enhances sensitivity to story structure, and guides the children toward making predictions and inferences—all important strategies that facilitate reading comprehension (Perfetti, Landi, & Oakhill, 2005; Snow et al., 1998).

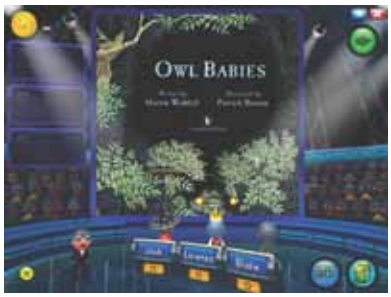
3. Instruction must be systematic. Orderly and coherent instruction that is cumulative and continually reinforced is most effective for children with reading difficulties (Snow et al., 1998; International Dyslexia Association [IDA], 2009; American Academy of Pediatrics [APA], 2009). The scope and sequence of SmartyAnts was created so that children begin with the simplest foundational skills and strategies (e.g., phonological awareness, letter names), and then progress to concepts of greater difficulty (e.g., blending sounds to decode words, spelling conventions, affixes, multisyllabic words). Later concepts are built upon earlier ones, and students are given ample opportunities to continuously use the knowledge they have accumulated along their literacy journey. Instruction is cumulative, creating a learning environment where children are always prepared for the next step. SmartyAnts gets children reading as soon as possible; once they've learned a few useful consonant sounds and a single vowel, they begin reading words, sentences, and stories. The culminating activity in each of the 69 lessons is building a story and a music video with the sounds and words mastered; both become a permanent part of the child's virtual library.

4. Instruction should have a "code" emphasis, but should provide literacy experiences that go beyond phonics. There is broad scientific consensus from influential national reading studies and landmark intervention studies that children with reading disorders learn best when the alphabetic code is a central part of the instruction (Adams,1990; Chall, 1967; Foorman et al., 1998; National Reading Panel, 2000; Snow et al., 1998; Torgesen et al., 1999; Vellutino, Scanlon, & Jaccard, 2003). Because of their weaknesses in phonological processes, struggling readers must be taught the code explicitly, systematically, and comprehensively if they are to learn how to read unfamiliar words accurately and automatically so they can make meaning from print. SmartyAnts is organized into 69 lessons spanning 11 reading levels—all teaching the most important phonics skills necessary for skilled reading.

Once the phonics skills for each particular lesson are taught and mastered, children use what they've learned to build engaging and amusing decodable stories that they can print out and proudly read at home. In addition, there are over 450 learning songs in the SmartyAnts world to support instruction and facilitate memory of the letter–sound correspondences and other phonics skills.

While much of the instruction is phonics-based, SmartyAnts also provides ample opportunities to experience rich literature licensed

from Candlewick Press. Children experience the sheer joy of a character they can relate to, a clever turn of phrase, or a poignant story, all



while learning valuable comprehension strategies, developing a deeper vocabulary, and becoming sensitive to text structure and plot development.

5. Instruction must be intensive, provide corrective feedback, and offer ample opportunities for practice. Results of the above-mentioned intervention studies and others (e.g., Vaughn & Linan-Thompson, 2003) suggest that children with reading disorders require more intensive instruction than typical readers. Brain imaging studies demonstrate the positive impact of intensive intervention; pre- and post-test scans reveal that the neural circuitry begins to function more like that in skilled readers after intensive interventions that are explicit, systematic, and code-based (Eden et al., 2004; Shaywitz, 2003; Simos et al., 2002; Temple et al., 2003). For a child at risk of reading failure or already falling behind, a 30-minute individualized SmartyAnts session each day matches the intensity of the most effective interventions (Torgesen et al., 1999). The coach provides immediate corrective feedback in a kind and supportive way, and scaffolding is added whenever needed. Mistakes are viewed

by the coach as stepping stones to success, thus encouraging the child to take the same positive perspective. Finally, SmartyAnts provides sufficient practice in all aspects of phonological processing, phonics, and reading decodable text at the child's level, resulting in new and strengthened neural connections necessary for skilled reading.

6. **Multisensory instruction is recommended for children with reading disorders**. Although the multisensory principle—the idea of using two or three learning modalities (e.g., seeing, listening, speaking)—has not yet been isolated in controlled, comparison studies of reading instruction, the International Dyslexia Association states that "most programs that work do include multisensory practice for symbol learning" (IDA, 2009). Because the novice reader is required to simultaneously link auditory stimuli (sounds) and visual stimuli (symbols), often with a kinesthetic component such as speaking or writing, it is reasonable to expect multisensory instruction to confer some advantage to learning.

SmartyAnts provides a multisensory experience for children throughout all activities. When children are learning the letter names, they not only see the letters and hear the names, they also "paint" each letter with their mouse, in colors and designs of their choosing as they are guided in proper letter formation. When children are taught letter sounds, they see each letter and hear its sound as they pump it up with a virtual bicycle pump.

Each time a letter, letter string, or word is presented visually, the child is given the sound simultaneously. Words in stories are highlighted visually as they are read aloud so that children are explicitly shown the connection between what they hear and what they see.

Finally, preliminary pilots of the program with struggling readers have shown that almost all children spontaneously say the sounds aloud as they are playing, blending, and building words in the SmartyAnts World—another multisensory experience!

7. **Instruction must be motivating.** Children who have experienced prolonged reading failure are at risk for frustration, discouragement, and demoralization. Their efforts and energies are often spent trying to hide their perceived shortcomings from peers and teachers alike. Interventions for

these children must be motivating and non-threatening. In SmartyAnts, children are provided with myriad opportunities to choose their own learning environment. Research shows that when children are given choices in reading instruction, their sense of self-efficacy improves and they spend more time reading (Cordova & Lepper, 1996; McLoyd, 1979; Sweet, Guthrie, & Ng, 1998). While children always work at their appropriate individual skill level in the SmartyAnts World, they have the option to choose their dog, friends, activities, level of difficulty, and opportunities for extra scaffolding whenever they need it.

As they progress through the curriculum, children earn medals, trophies, and coins that can be spent in the virtual store.

Children are able to see their accomplishments grow as their virtual library fills with the books and music videos they've created.

Each time a child earns a letter, a sound, or a word, their ant's picture is taken by the Daily Woof Newspaper photographer and appears in the online newspaper along with an article documenting their successes.

And as an added confidence booster, each child is invited to create a fan club of friends and/or relatives who will receive news of daily achievements via email. Internal motivation results from the joy and satisfaction of finally finding success in learning to read!

Conclusion

Children at risk for reading failure need and deserve effective reading instruction. Learning to read is a complex skill; teaching it is equally complex. As esteemed reading researcher Dr. Luisa Moats said in the title of her monograph about the challenges faced in reading instruction, teaching reading is "rocket science" (1999). Unfortunately, many teachers

are not provided with pre-service or in-service training that gives them the tools to teach reading effectively, especially to those children with reading disorders (Cunningham, Perry, Stanovich, & Stanovich, 2004; Moats & Lyon, 1996; Scarborough, Ehri, Olson, & Fowler, 1998; Spear-Swerling & Brucker, 2003). Consequently, the achievement gap in children with reading disorders is not closing (Hanushek, Kain, & Rivkin, 1998), and this is true whether children are pulled out of class for traditional special education support or served in inclusive education models (Zigmond et al., 1995).

SmartyAnts was developed to provide teachers and children with an instructional tool that is steeped in the kind of pedagogy, deep content knowledge, and insights into language structure that research has deemed necessary for teaching struggling readers. It has all the elements recognized by reading researchers as essential for the effective instruction of children at risk for reading failure and children who have already fallen behind. SmartyAnts is explicit, systematic, multisensory, intensive, motivating, and responsive to individual differences and needs. It provides abundant opportunities for children to read text at their level. It is code-based, yet filled with authentic experiences in language-rich literature. In sum, SmartyAnts has the potential to create a whole new trajectory for children with reading difficulties - a trajectory that is marked by success and joy instead of failure and frustration.

Author

Mia Callahan is a teacher, reading researcher, and school psychologist who has worked directly with children for over 30 years. After teaching first and second grade for 10 years, she began a career focused solely on children with reading disorders. With a commitment to teaching struggling readers of all ages in one-on-one, small group, and classroom settings, Mia has used structured, systematic, explicit, and multisensory approaches to lead her students to successful literacy outcomes. As a researcher, Mia has studied the cognitive and neurobiological underpinnings of reading acquisition and development, and published articles in peer-reviewed journals on teacher training for literacy instruction. As a school psychologist, she has worked closely with children, families, and teachers to assess and treat reading disorders of all kinds. Mia is a graduate of Stanford University and earned a Ph.D. in reading development and educational psychology from the University of California, Berkeley, where she received the P. David Pearson Contribution to Reading Award, and the Contribution to the Study of Dyslexia Award.

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